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FIELD STUDY OF DISPOSED WASTES FROM ADVANCED COAL PROCESS

Quarterly Technical Progress Report
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(Final Report)

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1.0 PROJECT OBJECTIVES

The Department of Energy/Morgantown Energy Technology Center (DOE/METC) has initiated research on the disposal of solid wastes from advanced coal processes. The objective of this research is to develop information to be used by private industry and government agencies for planning waste disposal practices associated with advanced coal processes. To accomplish this objective, DOE has contracted Radian Corporation and the North Dakota Mining and Minerals Resources Research Institute (MMRRI) to design, construct and monitor a limited number of field disposal tests with select advanced coal process wastes. These field tests will be monitored over a three year period with the emphasis on collecting data on the field disposal behavior of these wastes.

There has been considerable research on the characteristics and laboratory leaching behavior of coal wastes -- a lesser amount on wastes from advanced coal processes. However, very little information exists on the field disposal behavior of these wastes. Information on field disposal behavior is needed a) as input to predictive models being developed, b) as input to the development of rule of thumb design guidelines for the disposal of these wastes, and c) as evidence of the behavior of these wastes in the natural environment.

2.0 OBJECTIVES FOR THE THIRD QUARTER CALENDAR YEAR 1986

The project was started in May 1986. Objectives for the third quarter (and into October) were as follows:

- Formalize the basis for the test designs;
- Select design options;
- Prepare a draft of the Test Design Manual; and

- Initiate work on the Test Procedures Manual.

3.0 ACTIVITIES FOR THE REPORTING PERIOD

Formalize Basis for Test Designs

The initial activities included a review of the pertinent literature (Subtask 1.1), the identification of test design options and the gathering of data about these options (Subtask 1.2).

The literature contains abundant information on waste characteristics and laboratory leaching behavior of select wastes from advanced coal processes. However, the literature contains very little information concerning the field disposal behavior of these wastes. Additionally, the ability to predict field behavior based on laboratory characterization data is not developed. Based on these findings in the literature, there is a need for data from field disposal studies conducted in natural settings for advanced coal wastes. These experiments would provide data to validate and calibrate predictive models, support development of design guidelines for disposing of these wastes, and demonstrate the behavior of these wastes in natural settings.

Select Design Options

A number of alternatives exist for the design of the field studies. In this task, we tabulated the possible design options and evaluated them based on their ability to achieve the objectives of the project. Three separate objectives were considered in selecting the design options: A) to provide data for development and validation of predictive models, B) as data input to design guidelines, and C) to demonstrate the behavior of advanced coal process wastes in the environment. Each objective may require a different experimental design. The major design alternatives are summarized below.

Waste type. Based on experience in both existing and emerging coal conversion technologies, two technology areas which will have the greatest impact on increasing coal utilization will be fluidized bed combustion to generate steam and integrated gasification combined cycle power generation. Advanced coal cleaning, advanced flue gas desulfurization, hot gas clean-up and coal slurries will have a positive effect on increasing coal ulilization, but not to the same degree. The wastes generated by these processes will have varied physical and chemical properties. The properties that will have the greatest affect on solute transport are permeability, leachable trace metals, leachable trace organics, leachable total dissolved solids (i.e., sulfate) and extreme pH in leachate.

Climate. Water balance and temperature are the two most important climatic variables which may affect test design. By considering the factors that make up these two variables, the continental United States can be divided roughly into 12 regions, each defined by temperature (cold, moderate or warm) and water balance (dry, moderate wetness or moist). These divisions can be further grouped into three climatic divisions: wet and cold, wet and warm, and dry. These divisions will be used in selecting test sites that are representative of the broad climatic regions of the U.S.

Disposal facility type. Advanced coal processing wastes are expected generally to use the same types of waste disposal facilities as coal combustion industries use. These facility options are landfills, mines and surface impoundments. Accordingly, the design of field tests will consider these three facility types.

Interface between waste and soil. An important aspect of the design of advanced coal waste management facilities is the nature of the system which separates the waste mass from the surrounding soils. In an engineered disposal system this interface may include liners and leachate collection systems. However, it is imperative in the design of this project that information on the interactions between the waste and surrounding environment be collected. This information is needed to assess the quantity and quality of leachate generated from the waste, the degree of attenuation in the soil beneath the waste, and the ultimate inflow to the groundwater. Therefore, controls, such as liners, between the waste and the environment will not be designed into the tests. The exception to this will be special cases where the potential to contaminate groundwater exists or permits require such a system.

Soil conditions. A major issue here is whether the soils in the design should remain undisturbed. Given the complexity of unsaturated flow and its dependance on soil structure, meaningful data applicable to full scale disposal facilities can only be obtained if the soils are undisturbed.

The characteristics of the soils in the vadose zone will be highly variable even within a region. However, it is possible to identify the basic options which are available for the field tests and can subsequently be related to future disposal facilities. These options are the thickness of the vadose zone, hydraulic properties of the vadose zone, clay content of the soils, chemical makeup of the soils and organic content of the soils.

Groundwater conditions. The groundwater is that zone of the substrate around a disposal facility that is saturated with water. This zone is the final recipient of infiltrating leachate and often the principle environmental target for impacts of waste disposal. The properties of the groundwater zone which are considered most important to design of the tests are quality of the groundwater, flow rates, depth to aquiclude and lateral size of aquifer. These parameters are important because they affect the rate at which contamination from a test facility will spread in the aquifer and the damage which contamination of the aquifer would cause.

Monitoring Approach. The objective of monitoring the field tests will be to obtain information on the phenomena of interest. Monitoring of the leachate in the field tests can be accomplished by in situ techniques, such as lysimeters, or by coring of the waste followed by analysis of the waste and/or leachate. Measurements on flow of moisture through the waste and vadose zone can be accomplished using in situ techniques such as neutron probe access tubes, tensiometers or resistance blocks. Transformations in the leachate due to chemical reactions, biological activity or attenuation by the soils can be monitored in a manner similar to the waste leachate monitoring, i.e., collection of the pore water followed by chemical analysis of the constituents in the water. Finally, the monitoring of the zone of saturation (groundwater) can be accomplished by the collection of water and soil samples. Water samples from the zone of saturation can be collected using monitoring wells and soil samples can be collected using the coring techniques used for the waste and soil sampling.

Other Aspects of Test Design. The major technical criteria in designing the field tests, as stated above, are 1) how closely the field tests represent the range of disposal conditions anticipated for advanced coal wastes, and 2) the amount of information the design will provide on the phenomena of interest. However, other considerations which will be factored in to the design of the tests include the ability to obtain permits for the test site, the ability to obtain access to the site, potential risks to the environment from conducting the tests, and integration of this field project with other research in the area.

4.0 PROBLEMS ENCOUNTERED

No problems were encountered.

5.0 ACTIVITIES PLANNED FOR THE NEXT QUARTER

The following activities are planned for the period of November, 1986 through January, 1987:

- The revised draft of the Test Design Manual will be delivered to the COTR at the end of December.

- The first draft of the Test Procedures Manual will be prepared and delivered to the COTR in early January. This document will contain a detailed listing and description of the procedures for conducting the field tests. Each procedure will be described or referenced in detail. Also, the rationale for selection of a procedure will be given, as well as any alternate procedures and their applicability.

- Work on Task 2.3, Identification of Specific Test Cases, will continue during this period. In this task, the highest priority test cases will be selected for review by the COTR.

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